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| **Environments** | **Investigation 4:** | **Aquatic Environments** |

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| **How this investigation fits within the Concept and Lesson Map:** |
| In the prior investigations, students had experiences with identifying environmental factors and observing a range of tolerance in terrestrial environments. Now, in an aquatic environment, students are ready to discover that organisms can change the environmental factors. In this case a goldfish changes the acidity of the water environment by giving off CO2. This investigation helps students generalize their ideas about organisms to other environments beyond terrestrial. |

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| **Overarching Question(s) for the Whole Investigation** |
| How do organisms change the environment and how do we measure these changes? |

**How People Learn #1: Preconceptions**

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| **Eliciting student ideas:** |
| Concept cartoons- Small Fish 6.8 and Pond Life 6.10. Both of these help students activate background knowledge about: invisible environmental factors (gases), that organisms have a range of tolerance (live or die based on environmental factors), how fish/plants use and produce gases, how the environment influences living organisms and how the organisms can change the environment. Cartoon 6.8 is best used before Part I and cartoon 6.10 before Part 2. |

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| **Common Student Preconceptions:** |
| * Students often think of organisms as independent of each other (Leach et al., 1992). This could lead them to not look beyond the simple food web connections and remain unaware of subtle relationships between an organism and the environment. * The logical thinking required to understand the connection between the fish and the changing acidity involves causes and effects that might be challenging for many students. Refer to the bulleted list on page 6 of the investigation booklet to support student understandings. |

**How People Learn #2: Facts/Concepts/Knowledge**

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| **WA State Content Standards “Science Domains” (EALR 4)** | |
| 4-5 LS2E | All plants and animals change the ecosystem where they live. If this change reduces another organism’s access to resources, that organism may move to another location or die. |
| **WA State Science Standards “Crosscutting Concepts and Abilities” (EALRs 1-3)** | |
| 4-5 SYSC | Systems have inputs and outputs. Changes in inputs may change the outputs of a system. |
| 4-5 INQD | Investigations involve systematic collection and recording of relevant observations and data. |
| 4-5 INQF | A scientific model is a simplified representation of an object, event, system, or process created to understand some aspect of the natural world. When learning from a model, it is important to realize that the model is not exactly the same as the thing being modeled. |

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| **Key Understandings for the Teacher:** |
| * The acidity is an important environmental factor in aquatic environments. * When CO2 dissolves in water, it makes the water acidic. * Bromothymol Blue (BTB) is a chemical indicator that changes color depending on the acidity of the water. This allows students to observe and infer that the fish is making the water more acidic. Without the BTB indicator, this change in acidity would be invisible to students. When the acidity increases the water with BTB will change from sky-blue to green or yellow (see pg. FOSS Investigation 4, pg. 14). |

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**How People Learn #3: Metacognition**

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| **Metacognition: How did my thinking change? What caused the change? How did I come to believe this?** |
| Students journal throughout investigation 4 in science notebooks using the prompt, “How are the plants and animals changing the aquarium environment and what factors are being changed?” For example, this could be an on-going list of evidence that helps students understand that there are many visible and invisible changes happening to both the organisms and the environment. Students revisit their list of changes over time at end of investigation. |

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| **Evidence of Student Understanding:** |
| * Looking at Student Work (LASW): Science notebooks, FOSS student response sheets, assessments. * As a way to reflect on the class’s collective growth of understanding about *how organisms influence their environments*, the teacher can guide a whole class sharing of student journal responses to the metacognitive prompt (record on whiteboard). * Teams of students design (draw) a labeled diagram showing an investigation similar to the aquatic environments investigation, but using a new environment and organism(s). Prompt students to add details showing how their new organism(s) possibly influence the environment and each other. During team presentations, look for evidence of student understanding of environmental factors/changes and vocabulary usage. |

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**Additional Information**

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| **Materials and Student Management** |
| * Warning: Timing for ordering organisms from Delta Education can be tricky due to availability and shipping delays. Typical orders will take 4-6 weeks to process and deliver. Water conditioning suggestions: fish will die unless tap water is pre-treated (set out overnight, add de-chlorinator drops, or use distilled water). * Goldfish purchased from local pet stores or those mailed by Delta Education may have underlying health issues, which might cause them to prematurely die. Even healthy goldfish might show signs of stress that could upset students. Be ready by having extra goldfish and time for students to process feelings. * **Mobile Inquiry Technology** (real time data collection using pH and temp probeware, computers): inquiry-based investigations designed to support FOSS Environments Module. You can check out a variety of probes at SMATE at WWU or your local university. http://probesight.concord.org/curriculum/template\_section.htm Scroll down to Environmental Studies and find: Monitoring an Aquarium, Monitoring a Pond, Creating a pH Scale |

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| **Timing Considerations** |
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| **Helpful Resources and Bibliography:** |
| Concept Cartoons in Science Education by Stuart Naylor and Brenda Keogh pg. 38, 40.  Washington Edition: Assessment Environments, Grade 5 version (Updated formative assessment packet, 2006)  Atlas of Science Literacy pg. 32-33.  Pre-conceptions: Refer to Benchmarks pg. 342, 5D Interdependence of Life  Mobile Inquiry Technology (real time data collection using pH and temp probeware, computers): inquiry-based investigations designed to support FOSS Environments Module. **http://probesight.concord.org/curriculum/template\_section.htm** Scroll down to Environmental Studies and find: Monitoring an Aquarium, Monitoring a Pond, Creating a pH Scale |